

REMARKS

By the present amendment, claims 1-4 and 6 to 11 are pending in the application.

Support For Claims

Claim 1 has been amended to recite the metal balls --having a diameter of 60 to 150 μm --. This is supported in the specification, e.g., at page 6, lines 9-10 and page 7, lines 3-4.

Claim 1 has been amended to recite melting the metal balls -- to form a plated layer--. This is supported by the specification as a whole and particularly page 2, line 10.

New matter is not being presented by the present amendment.

§102/§103

In the Office Action mailed April 21, 2002, the following rejections were made.

Claims 1-3, 7, 8, 10 and 11 were rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 5,762,258 to Le Coz.

Claims 4, 6 and 9 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,762,258 to Le Coz in view of U.S. Patent No. 4,980,240 to Dunaway et al.

These rejections, as applied to the amended claims, are respectfully traversed.

Patentability

The present invention defined by amended claim 1 is not disclosed or suggested by the cited references and is patentable thereover for the following reasons.

Claim 1 vs. Le CozDifference in Melted Form

Le Coz uses balls as a spacer element to provide a distance from a substrate or other bonding objects. To this end, melting of the balls must be performed to an extent such that even after the melting, the balls are in the form of a "bump" as shown in Fig. A attached hereto, the bump having a height ensuring the above-mentioned distance. It is herein defined that the "bump" has a form of an incomplete sphere having its sphere center contained therein as shown in Fig. A.

In contrast, the present invention relates to a surface finishing technology for coating electrodes or other plating objects by melting metal balls to form a plated layer thereon, which is clearly distinguished from the spacer member of Le Coz. It is herein defined that the "plated layer" contains no sphere center therein, as shown in Fig. B attached hereto.

Difference in Ball Size

Le Coz uses balls having a diameter of about 0.03 inch (about 760 μ m) (column 4, line 67 to column 5, line 3).

In contrast, the present invention uses balls having a diameter of 60 to 150 μ m, which is much smaller than

that of Le Coz. Balls of such a small size are very difficult to handle in comparison with the larger balls of Le Coz.

For example, Le Coz allows the balls to roll on a template 31 and to fall down in holes 35 and considers nothing about adhesion of the balls to the surface of the template 31.

In the present invention, small balls 60 to 150 μm in diameter are extremely light in weight and are very likely to adhere to a surface with a minute amount of grime or water absorbed thereto. Therefore, while arranging small balls of the present invention, the balls are very likely to adhere to the surface of an arrangement base plate and leave the adhered balls as excess balls.

Le Coz provides no solution to eliminate the excess balls on the template 31.

According to the present invention, as shown in Figs. 2(a) and 2(b) of the present application, arranging metal balls includes lowering an arrangement base plate 13 to above a ball container 10 and picking up balls from the ball container 10 by vacuum suction at through holes 11, thereby reducing probability of balls contacting the surface of the arrangement base plate 13. Adhered excess balls, if any, can be removed by applying vibration to the arrangement base plate.

Concerning the removal of excess balls by vibration, the Office Action states at page 4, lines 4 to 8,

that Le Coz teaches a provisionally arranging and holding procedure, wherein excess metal balls 15 are adhered to the arrangement base plate 11, 21, 31 and removed by applying vibration from the suction of the arrangement base plate.

However, this observation of the Office Action is not correct. Le Coz, column 5, lines 32 to 36, actually reads:

"Accordingly, this vacuum assures positive retention of the larger solder ball elements 15 with the smaller holes 13 to thus prevent removal of these solder ball elements as may occur (e.g., caused by vibrations) during normal additional manufacturing operations."

This statement of Le Coz only means that removal of the balls may undesirably occur due to vibration during the normal manufacturing process. Le Coz is quite silent about intentional removal of excess balls or the advantageous effect thereof.

The Office Action at page 5, the third line from bottom to page 6, line 4, states that Le Coz discloses vacuum through apertures 33, which imparts ultrasonic vibration to the template or suction head.

However, this position taken by the Office Action is only speculation. Le Coz actually discloses or suggests nothing about vibration caused by vacuum.

Le Coz is different from the present inventive intentional application of vibration to remove excess balls. The present inventors first found that ultrasonic vibration most effectively removes excess balls, which is clearly

different from Le Coz's non-intentional vibration undesirably occurring during normal manufacturing process.

Dunaway

Dunaway relates to forming a bump by vacuum deposition and is essentially different from the present invention.

The bump formation by vacuum deposition uses vacuum equipment costing too much for commercial application and also involves large material loss causing environmental problems to occur. Moreover, vacuum deposition requires control of vapor pressure of the source material to provide a product with desired chemical composition, which makes it difficult to form a metal alloy with a desired composition.

In contrast, the present invention does not require any specially designed equipments and instead uses a selected ball size for a desired amount of plated layer in which material loss is minimized and the production cost is reduced in comparison with the vacuum deposition process. The present invention also has the advantage that a plated layer with a desired chemical composition, including metal alloys, can be easily obtained merely by using metal balls of a desired material, increasing freedom of material selection.

The Office Action states at page 6, lines 7 to 10, that Dunaway teaches balls 80 made of gold and a lead frame plated with gold.

However, Dunaway discloses nothing about gold balls and it is submitted that Dunaway forms gold bumps by wet

process plating. It is also submitted that the lead frames of Dunaway are plated with gold through wet process. The wet process causes an environmental problem due to the waste solutions, requires complicated equipment, and is poor in material selection.

The present invention provides a novel partial plating process, which is not a wet process, and only requires relatively simple equipment causing no environmental problems with improved freedom of material selection.

Thus, the present invention is clearly distinguished from Dunaway.

Summary

To summarize, the present invention defined by amended independent claim 1 is not disclosed or suggested by Le Coz and/or Dunaway. Therefore amended independent claim 1 is patentable over Le Coz and/or Dunaway.

Dependent claims 2 to 4 and 6 to 11, dependent from claim 1 directly or indirectly, include all of the features of claim 1 and are therefore patentable for the same reason as discussed above for claim 1. The dependent claims are also separately patentable for the reasons discussed above.

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application be allowed and passed to issue.

Respectfully submitted,

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